

A New Species of *Aridarum* (Araceae: Schismatoglottideae) from West Kalimantan, Indonesian Borneo

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Aridarum embaloehense H.Okada & Tsukaya (Araceae: Schismatoglottideae), a new species from Betung Kerihun National Park, West Kalimantan, Indonesia, is described and illustrated.

Key words: Araceae, *Aridarum embaloehense*, biodiversity, Borneo, new species, rheophyte, West Kalimantan, wet tropics

For future generations, to conserve primary tropical rain forests in the remaining boundary areas in the heart of Borneo, the Indonesian government is collecting basic biological information from these areas. Several Japanese investigators have agreed to the proposal from Indonesian researchers to analyze the flora of the area. In the connection, we conducted field studies in 2004 in Central Kalimantan and from 2009 to 2011 in West Kalimantan. During our field surveys, various new taxa, two new genera, eight new species, one new variety and two new formas, were discovered (for example, Okada & Tsukaya 2010, Tsukaya *et al.* 2011, Tsukaya & Okada 2012). This report presents the latest results of field surveys in those areas.

Aridarum Ridl. (Araceae), a genus of rheophytes, is endemic to Borneo. Based on new collections, 10 species of *Aridarum* are known from northwest of Borneo, Malaysia (Sarawak), Brunei and Indonesia (West & Central Kalimantan) (Okada & Mori 2000, Okada 2006, Wong & Boyce 2007).

During our field work in 2011 in the western part of Betung Kerihun National Park, West Kalimantan, Indonesia, 10–20 km from the bound-

ary between West Kalimantan and Sarawak, we found an unknown species of *Aridarum*. Although nearly all species of *Aridarum* have characteristically excavated stamens (cf. Mayo *et al.* 1997), *A. incavatum* H.Okada & Y.Mori has stamens without excavation (see Figs. 1B, G and H in Okada & Mori 2000). The newly discovered species lacks excavations on the connective and has various other characteristics that distinguish it from *A. incavatum*. For example, the short horns of the thecae are hemispheric to ellipsoid (see “key to the species” below). We therefore describe these plants as a new species and provide a key to all the species of *Aridarum*.

***Aridarum embaloehense* H.Okada & Tsukaya, sp. nov.** —Figs. 1 & 2.

Stamens without excavation on the connective similar to *Aridarum incavatum*, but differing in thecae with hemispheric to ellipsoid short horns and leaves shining dark green instead of shining green in *A. incavatum*.

Typus. INDONESIA, West Kalimantan, Kabupaten Kapuas Hulu, Putussibau, Sg. (River) Tekelan, Sg. Sabong, a branch of Sg. Embaloh, Betung Kerihun National Park, 01°24'18" N, 112°28'31" E, ca.190 m alt., 22 December 2011. *H. Okada, H. Tsukaya & A. Soejima WKO-11-03* (holo- BO; iso- HYO, KYO, TI, TNS).

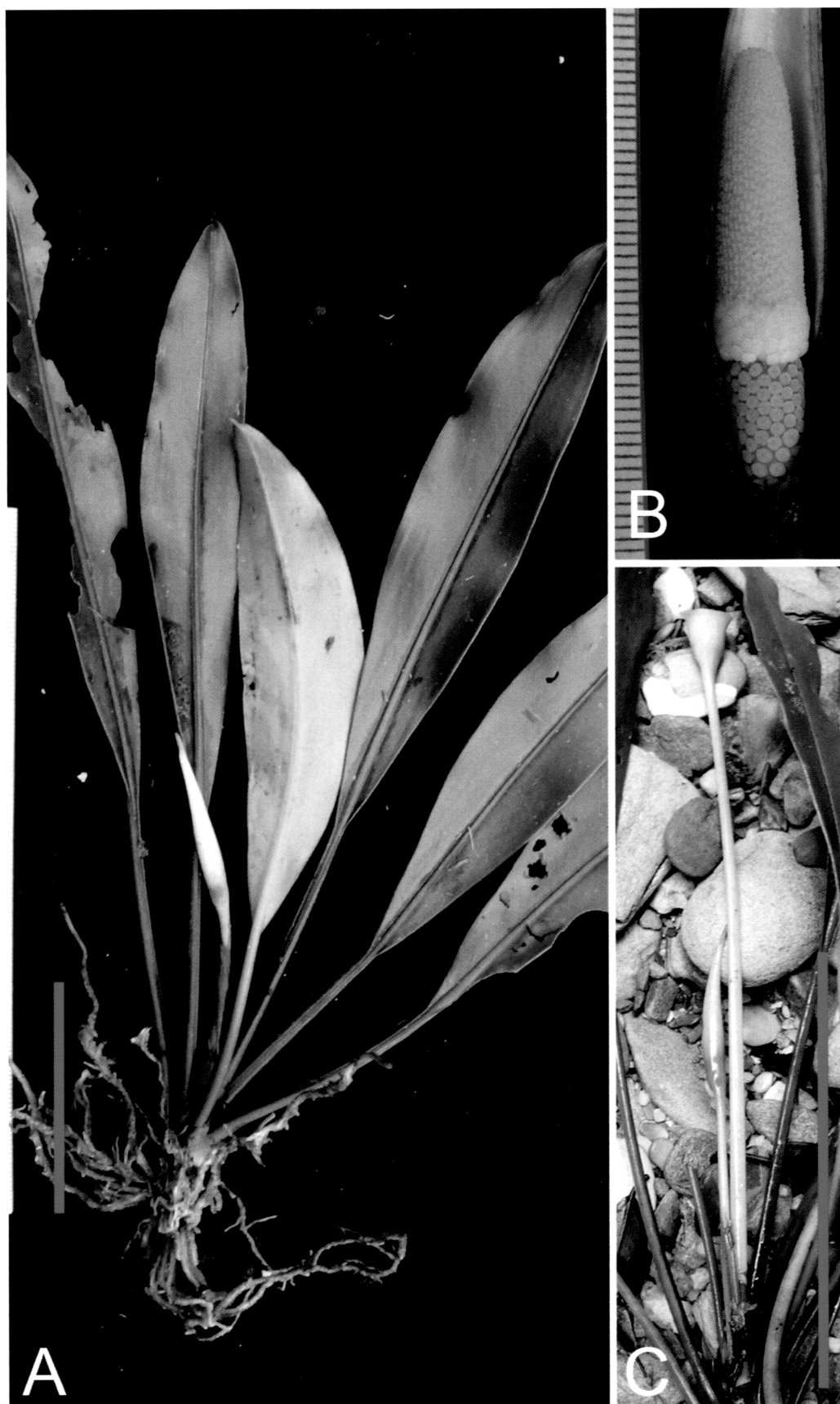


FIG. 1. *Aridarum embalohense*. A: Whole plant with young spathe. Red line 5 cm. B: Spadix just before anthesis. From bottom to top pale green pistillate zone, white interstitial sterile zone, pale green staminate zone. Scale 1 mm. C: Young inflorescence and immature infructescence. Red line 10 cm. Photographs from fresh materials (H. Okada et al. WKO-11-03) at type locality.

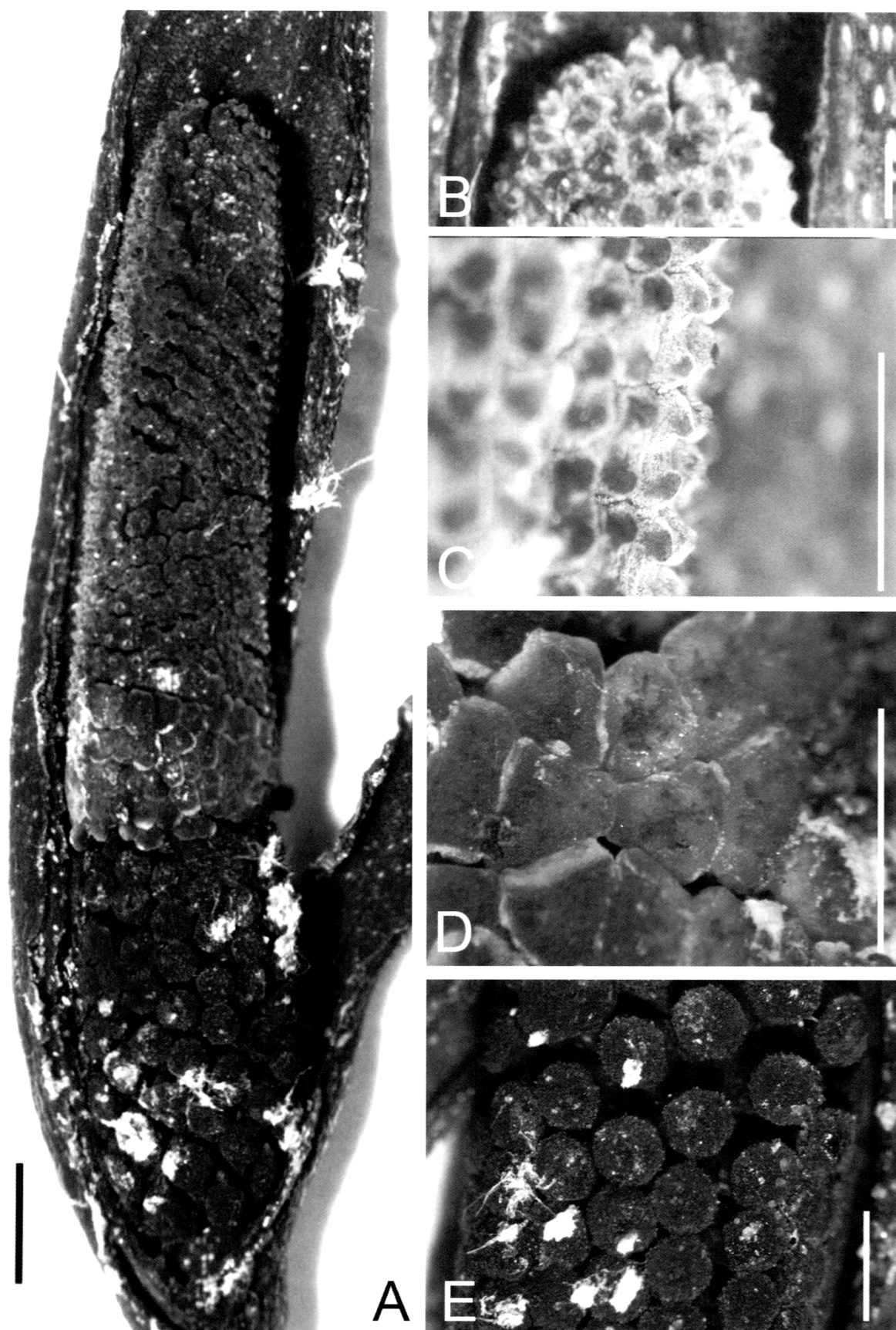


FIG. 2. Spadix of *Aridarum embaloense*. A: Whole spadix. Scale 2 mm. B: Apex of spadix. Staminate flowers fertile to apex. C: Stamens with two horned thecae. Note no excavation at connective. D: Stamminodes in interstitial part. E: Ovaries with diskoid stigma. Scale for B–E 1 mm. Photographs from holotype, H. Okada *et al.* WKO-11-03.

Herbs, to ca. 20 cm* tall. Roots robust, creeping on rocks. **Stems** erect, to ca. 1.5 cm long, 1 cm in diam. **Leaves** spirally arranged; petiole stout, glabrous, dark green, 9–16 cm long, 1–2 cm in diam.; lamina coriaceous, glabrous, lanceolate, 12–15 cm long, × 2–3 cm wide, base cuneate to decurrent, margin entire, thickened, apex acuminate, abaxially pale green, adaxially shining dark green, midrib prominent, primary lateral veins abaxially weakly prominent, adaxially obscure. **Inflorescence** solitary, erect; peduncle ca. 11–17 cm long, 1–2 mm in diam. **Spathe** not constricted, white, 3–5 cm long, ca. 1 cm wide, apex acuminate, upper 3/4 of spathe shed after anthesis, lower part persistent and ca. 1–1.5 cm long. **Spadix** (at somewhat young stage) ca. 1.5–2 cm long, 3–4 mm in diam. when dried; pistillate zone basal, ca. 4–7 mm long, pale green when fresh; staminodial zone intermediate, 2–3 mm long, white when fresh; staminate zone terminal, 9–11 mm long, fertile to apex**, pale green when fresh. **Pistillate flowers** ca. 0.4 mm in diam., stigma sessile, disk-like, ca. 0.3 mm in diam. **Staminodes** ca. 0.2–0.3 mm in diam., globose, more or less depressed. **Staminate flowers** in pairs, connective not excavated, ca. 0.5 mm long and wide, horns of thecae hemispheric to ellipsoid. **Infructescence**: peduncle ca. 14–18 cm, surrounded by persistent funnel-shaped lower part of spathe, 1–1.5 cm long, 1–1.5 cm wide.

Distribution. Known only from the type locality.

Habitat. On rock in rheophytic zone beside a rapid stream.

Notes. Although vast morphological variation in leaves is quite evident, even within a single

family or genus, the reason why a particular type of leaf shape has evolved or been selected for is not yet understood (see review by Nicotra *et al.* 2011, Givnish 1979). One of the exceptional cases is the variation in leaf index [I: the ratio of leaf length to leaf width (van Steenis 1981)], which is quite commonly seen in natural populations. Van Steenis (1981) suggested that the larger leaf index or narrower leaf shape in rheophytes growing on river banks is linked to the speed of the current or the duration of submersion.

Aridarum consists only of rheophytes, but the lamina not only vary in thickness but also in shape from species to species, ranging from linear in *A. montanum* Ridl., I = about 16 [estimated from a drawing (Ridley 1913)], to broadly oblanceolate to elliptic or narrowly obovate in *A. crassum* S. Y. Wong & P. C. Boyce [I = about 3; estimated from a photograph (Wong & Boyce 2007)] and *A. burttii* Bogner & Nicolson [I = about 3; estimated from a drawing (Bogner & Nicolson 1991)]. *Aridarum embaloense* has lanceolate leaves and an estimated moderate value, i.e., I = about 6 [mean ± SD = 5.6 ± 0.7 (n = 9)]. The genus *Aridarum* may therefore provide suitable material for analyzing relationships between leaf morphology, genetic variation and environmental factors.

It is notable that, although the genus *Aridarum* is diagnostically characterized by excavated stamens (cf. Mayo *et al.* 1997; p. 86.), *A. incavatum* and *A. embaloense* show the exceptional combination of the spadix being fertile to the apex and not excavated at the connective of the stamens, indicating the possibility that they belong to a different taxon, genus or section.

Key to the species of *Aridarum* (modified partly from the key proposed by Wong & Boyce [2007])

- 1a. Thecae on opposite sides of stamen (Sect. *Aridarum* Ridl.).....2
- 1b. Thecae together on one side of stamen (Sect. *Caulescentia* M.Hotta).....7
- 2a. Spadix fertile to apex, stamens not excavated.....3

*Measurements in this description were based on dried herbarium specimens.

**Senior author confirmed pollen grains in thecae at apex.

- 2b. Spadix with an appendix of staminodes, stamens excavated4
 3a. Horns of thecae robust, conical *A. incavatum* H.Okada & Y.Mori
 3b. Horns of thecae hemispheric to ellipsoid..... *A. embaloheense* H.Okada & Tsukaya
 4a. Leaf blade almost linear; Sarawak (Santubong)..... *A. montanum* Ridl.
 4b. Leaf blade narrowly elliptic to elliptic.....5
 5a. Leaves distichous; Sarawak (vicinity of Matang)..... *A. borneense* (M.Hotta) Bogner & A.Hay
 5b. Leaves spiral.....6
 6a. Leaf blade stiffly coriaceous, adaxially glossy deep green when fresh; horns of stamen thecae rounded at apex; Sarawak (Gunung (Mt.) Gaharu)..... *A. crassum* Y.S.Wong & P.C.Boyce
 6b. Leaf blade rubbery-coriaceous, adaxially matte medium green when fresh; thecae horns pointed at apex; Sarawak (Bako National Park) and West Kalimantan *A. nicolsonii* Bogner
 7a. Stamens in pairs; thecae on inner face of each member of stamen pair8
 7b. Stamens solitary (but crowded); thecae on proximal (with respect to the spadix axis) side of stamen.....9
 8a. Horns of thecae shorter than width of stamen; Sarawak and Brunei..... *A. caulescens* M.Hotta
 8b. Horns of thecae longer than width of stamen; Sarawak..... *A. purseglovei* (Furtado) M.Hotta
 9a. Plants ca. 5–10cm tall, spathe 1.5–3 cm long, appendix about half as long as spadix; Central Kalimantan *A. minimum* H.Okada
 9b. Plants 20–30cm tall; spathe more than 4 cm long, appendix less than 1/3 of spadix 10
 10a. Stamens and staminodes coarsely verrucate; appendix well-differentiated; spathe beaked for more than half its length; West Kalimantan *A. rostratum* Bogner & A.Hay
 10b. Stamens and staminodes crispate; appendix reduced to a few terminal sterile stamens; spathe apiculate for less than 1 cm; Sarawak and West & Central Kalimantan *A. burtii* Bogner & Nicolson

We express our sincere thanks to the Secretariat of Permissions for Foreign Research, the Ministry of Research and Technology, Republic of Indonesia (RISTEK), who kindly gave us permission to conduct field research in West Kalimantan, and the Indonesian Institute of Science (LIPI) and the Betung Kerihun National Park Office, Department of National Parks, for kindly allowing this study in Betung Kerihun National Park, West Kalimantan. We thank Dr. Dedy Daernadi and Dr. Marlina Ardiyani of the Research Center for Biology, LIPI for their kindly arranging field research.

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Received July 30, 2012; accepted September 25, 2012